ON A NEW PORTABLE GALVANIC BATTERY.*

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IN an article published by Dr. Geo. W. Jacoby and myself (JOURNAL OF NERVOUS AND MENTAL DISEASE, 1884, No. 1), after having passed in review the galvanic batteries available for medical use, we came to the conclusion, that for a stationary battery the Leclanché is the best, and that the chloride of silver battery would answer best for portable use, were it not for its original high cost, its comparatively short life, and the difficulty attending its refilling with fresh chloride of silver, when exhausted.

Since that time nothing occurred to necessitate a change of opinion on our part in regard to the batteries mentioned in our article. During the last two years I have made various experiments with the object of finding a galvanic element which would answer the purposes of the general practitioner and not be open to the objections which are attached to the chloride of silver battery, and I trust I have now succeeded in finding a satisfactory answer to my inquiries.

Before presenting this battery to you it will be necessary to enter upon the train of thoughts which led to its construction.

1st. The polarization *in* the cell is inversely proportionate to the resistance either external or internal. Thus by making the resistance very high we may lower the polarization in the cell so much that a good galvanometer will be nearly or altogether insensible to it. By this means, as may be

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readily perceived, the necessity of a depolarizer is obviated.

To elucidate this point, let us take the case of a zinc carbon couple immersed in a watery solution of sal ammoniac. If we connect the zinc with the carbon by a conductor outside the cell, chemical action is set up; the chloride of the sal ammoniac as well as the oxygen of the water combine with the zinc. Ammonia and hydrogen accumulate on the carbon. Now, if the connecting conductor be of a low resistance, the chemical action will be a rapid one, the hydrogen will not have time to either dissolve in the surrounding fluid or to escape in bubbles, and being of a more electropositive nature than zinc will set up a counter current that will weaken the principal current (from zinc to carbon) or even completely neutralize it.

The accumulation of hydrogen, as in the case described, is called polarization in the cell.

To get rid of this hydrogen we use a *depolarizer—i. e.*, a substance that readily gives up, say chlorine or oxygen, to combine with the hydrogen as soon as it is evolved.

If, then, on the other hand, the chemical action is diminished by increasing the internal or external resistance, less hydrogen will evolve in the same unit of time; it will dissolve in the surrounding fluid, and less or no polarization at all, will occur.

2d. A high electromotive force being requisite for our purpose, zinc and carbon, as standing very far apart in the electromotive series, were chosen.

3d. The exciting fluid, a solution of sal ammoniac (1 to 4) recommended itself for the following reasons: it has no reaction on the zinc, when the battery is not working; it is not corrosive; and it easily dissolves the oxychloride of zinc formed during the action of the cell.

The result of all these considerations has been the battery I now have the honor to present for your inspection.

This battery contains thirty couples of carbon and zinc of the type used in the construction of Waite and Bartlett's bichromate battery.

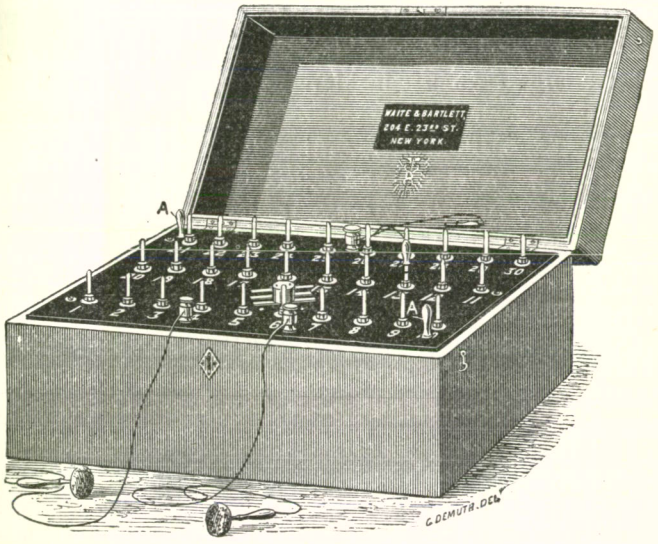
The couples are connected by screws to a hard-rubber

switch-board, having a plug and socket arrangement by which a number of cells can be thrown into the circuit.

On the switch-board are also a pole changer and a pair of binding posts.

Between the carbon and zinc of each couple a piece of stout asbestos paper is fastened by means of a few thin rubber bands.

The lower part is a trough composed of thirty hard-rubber cells, cemented one to another so as to prevent any fluid from



getting in between them. For further protection the trough is put in a tray of wood covered with an acid and water proof coating.

To fill the battery make a solution of a pound and a half of sal ammoniac to six quarts of water, fill all the cells nearly full, then by tipping the tray to a certain angle so that the superfluous liquid will run out, all the cells will be filled nearly to the same level.

This manner of filling is both expeditious and rational. By filling in the ordinary way you can hardly expect to fill all the cells to the same level. Now it is well known that one poorly filled cell tends to lower the efficacy of

the whole battery. It is also of importance to have all the zincs in the battery corroded uniformly.

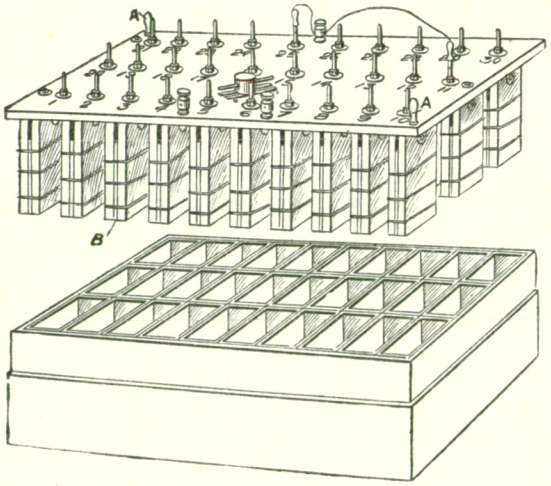
It remains to explain the rôle of the asbestos paper diaphragm between the zincs and the carbons.

Its purpose is threefold:

1st. It increases the internal resistance of the cell, which is, as I have already explained, of advantage.

2d. By its rough surface adhering to the carbon it facilitates the escape of the hydrogen bubbles, and thus acts as a depolarizer.

3d. It enables us to use the battery without the trough, the asbestos paper retaining sufficient fluid to keep the couples charged for a considerable time.



This last point is of extreme importance; it gives us a *really* transportable battery, without liquid liable to be spilled, and able to stand any position and any kind of jolting.

For the purpose of transportation, Messrs. Waite and Bartlett, who constructed this battery for me, had it so arranged that the lower part containing the tray with the cells, is left out, and the switch-board with the elements so fastened in the box as to be able to stand any amount of handling.

Now about the practical working of this arrangement. We have had this battery in daily use at the German dispensary for four weeks with the same filling of sal ammoniac.

About 7 A.M. this morning (July 23, '86) the cells were emptied and the box sent over to the meeting in Long Branch, and now, at 12.30 P.M., as you see, the battery gives a current sufficiently strong for all practical purposes.